

Technical Description Document (TDD)

Mission and Computing Support (MACS)

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National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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Technical Description Document (TDD)

MISSION AND COMPUTING SUPPORT (MACS)

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April 2000

National Aeronautics and Space Administration

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ABBREVIATIONS/ACRONYMS

AFP	Advance Function Printing
AFS	Application File Service
AGP	Additional General Provisions
AMMOS	Advanced Multimission Operations System
ATLO	Assembly, Test and Launch Operations
AT&T	American Telephone and Telegraph
BLITS	Bar Code Library Inventory and Tracking System
CDRL	Contract Data Requirements List
CM	Configuration Management
CMO	Contract Management Office
COTS	Commercial Off-The-Shelf
CR	Change Request
CSOC	Consolidated Space Operations Contract
CSR	Communications Service Request
DCE	Distributed Computing Environment
DEC	Digital Equipment Corporation
DFS	Distributed File System
DN-EU	Data Number to Engineering Unit
DNP	Develop New Products
DNS	Desktop Network Services
DRD	Data Requirements Document
DSN	Deep Space Network
DSO	Data Systems Operations
DSO-DDP	Data Systems Operations Data Delivery Point
DSS	Deep Space Stations
E	Event
ECR	Engineering Change Request
EIS	Enterprise Information System
ESD	Engineering and Science Directorate
FIS	Financial Information System
FOO	Facility and Operations Project Engineers
FR	Failure Report
FSW	Flight Software
GFE	Government Furnished Equipment
GLL	Galileo
GSE	Ground Support Equipment
HRS	Human Resources System
HSEMICs	Hardware and Sustaining Engineering Management Information Control System
HVAC	Heating Ventilation Air Conditioning
H/W	Hardware
IAW	In Accordance With

IBS	Institutional Business Systems
ICIS	Institutional Computing and Information Services Office
ILAN	Institutional Local Area Network
IMAP4	Interactive Mail Access Protocol 4
IOA	(CSOC) Integrated Operations Architecture
I.O.M.	Interoffice Memorandum
IPAC	Infrared Processing and Analysis Center
IPC	Information Processing Center
ISDN	Integrated Services Digital Network
IRAS	Infrared Astronomical Satellite
ISOE	Integrated Sequence of Events
ITL	Integrated Test Laboratory
ITS	Inventory and Tracking System
JPLNet	JPL Institutional Local Area Network
JURAP	Joint Users Resource Allocation Planning
LAN(s)	Local Area Network(s)
LATS	Lab Administrative Telephone Systems
LEO	Low Earth Orbit
MACS	Mission and Computing Support
MCT	Mission Control Team
MGDS	Multimission Ground Data System
MGS	Mars Global Surveyor
MOPS	Mission Operations Partnering and Support
MOS	Project Mission Operation System
MOU	Memorandum of Understanding
MSA	Mission Support Area
MSAS	Multimission Spacecraft Analysis System
MSFC	Marshall Space Flight Center
MTBF	Meantime Between Failure
MTTR	Meantime To Recovery
MVS	Multiple Virtual System
N/A	Not Applicable
NBS	New Business Systems
NEMS	JPL Property System
NISN	NASA Integrated Services Network
NOC	(Institutional) Network Operations Center
NOCC	(DSN) Network Operations Control Center
NODS	NASA Ocean Data Systems
NSS	Network Support Subsystem
NTE	Network Terminating Equipment
NT-1	Network Termination - 1
NSCAT	NASA Scatterometer
OAO	OAO Corporation
OPS	Operations
OS	Operating System

PAF	Position Authorization Form
PDME	Project Database Management and Execution
PDT	Pacific Daylight Time
PIO	Public Information Office
POP3	Post Office Protocol 3
PRD	Preliminary Requirement Document
PST	Pacific Standard Time
QA	Quality Assurance
QQC	Quantity Quality Continuity
RAP	Resource Allocation Process
RAPT	Resource Allocation Planning Team
RCP	Resource Cost Plan
RF	Radio Frequency
RIS	Resource Information System
RMDC	Radio Metric Data Conditioning
S and MP	Science and Mission Planning
SAR	Synthetic Aperture Radar
SAS	Supplies and Services Acquisition System
S/C	Spacecraft
SCET	Spacecraft Event Time
SCLK	On-Board Spacecraft Clock
SDSIO	Science Data Systems Implementation and Operations (contract)
SFOF	Space Flight Operations Facility
SFOS	Space Flight Operations Schedule
SLA	Service Level Agreement
SPICE	Spacecraft Ephemeris, Planetary/Satellite Ephemeris and Constants, Instruments, C Pointing Matrix, Event Information
SR	Service Request
S/W	Software
TDD	Technical Description Document
TMOD	Telecommunication and Missions Operations Directorate
TMS	Tape Management System
TT&C	Telemetry, Tracking and Commanding
VLBI	Very Long Baseline Interferometer
VOCA	Voice Operations Communications Assembly
WAN	Wide Area Network
WBS	Work Breakdown Structure
W/S	Workstation

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INTRODUCTION

The Mission And Computing Support (MACS) Contractor in accordance with contract number 958226 shall provide engineering, operations, and maintenance support to JPL core systems and Flight Projects. JPL Flight Projects support NASA's robotic planetary and interplanetary exploration, and Earth applications programs.

Since 1988, the Mission and Computing Support (MACS) Contract has provided Jet Propulsion Laboratory (JPL) the continuity, flexibility, and responsiveness that is required in meeting JPL's computing and mission operational needs through effective contract management. The requirements of MACS are generically grouped into functions. There are nine major functional areas.

- **Contract Management Office**
- **System Development**
- **Mission Operations**
- **Mission Support Systems**
- **Institutional Computer & Communications, Hardware and Sustaining Engineering**
- **Institutional Enterprise Information System Applications and Operations**
- **Institutional Network Operations**
- **Institutional Network and Telecommunications**
- **Facilities Services**

The Telecommunications and Missions Operations Directorate (TMOD) and Institutional Computing and Information Services Office (ICIS) are central elements supported by the MACS contractor.

The TMOD consists of distributed mission support computing systems, other equipment, and personnel located in Building 230, 264, and portions of Building 600 and 601.

The Information Processing Center (IPC) consists of large mainframe computing systems, other equipment, and personnel located in Building 600 and 601 in support of mission operations, imaging and institutional computing.

The computing systems that will be supported by this contract consist of those core systems and distributed Flight Project specific computing systems, other

equipment, and personnel located in contractor facilities as well as portions of Buildings 264, 230 and others. These computers, equipment and personnel are other than those provided and supported by the Consolidated Space Operations Contract (CSOC) in Building 230.

The MACS Contractor shall provide the maintenance on JPL Institutional workstations. The CSOC contractor(s) provide maintenance on the Advanced Multimission Operations System (AMMOS) workstations. Flight Project specific workstations are JPL Flight Project choice on whether the MACS Contractor, the CSOC contractor(s), or some other vendor shall provide a cost effective way to service their equipment (see Definitions, pages 5-7).

The Information Processing Center (IPC) consists of distributed computing servers, network and other equipment. Contractor personnel located in contractor facilities shall support project mission operations and institutional (ICIS) network operations and administration.

The nine functions listed above (and as described by this TDD) may be viewed as a baseline Work Breakdown Structure (WBS) for activities performed by JPL's Engineering and Science Directorate (ESD) to support JPL's TMOD, Flight Projects and ICIS. In order for JPL's ESD to meet its commitments to these JPL organizations, ESD needs to use a combination of JPL and Contractor talent working in the WBS elements of this TDD. An individual WBS element for a specific project, however, may or may not use Contractor personnel depending upon need. In some instances, the WBS elements are 'Support Effort' (see definitions, page 6 of this TDD), and in others, the WBS elements are 'Task Effort'. The Statement of Work (Article I of this contract) defines the scope of the initial set of Tasks. Roles and Responsibilities of the Contractor and Interfaces with the Consolidated Space Operations Contract (CSOC) contractors are contained in Appendix A.

JPL has responsibility for the architecture of deep space exploration operations systems. CSOC provides NASA with an Integrated Operations Architecture (IOA). The deep space exploration operations systems will evolve with time as consistent with the IOA as can meet deep space exploration needs. The Contractor shall support JPL's efforts that will include CSOC engineering interfaces (see Appendix A, Roles and Responsibilities).

Many of the eight functions described by this TDD will infuse Develop New Products (DNP) process improvements during the period of performance of this contract. JPL's DNP is an integrated set of processes, models, tools, information systems, facilities, and training courses whose purpose is to streamline the engineering of spacecraft, instruments, core ground systems, and software at JPL in an era of increased expectations and shrinking budgets. DNP facilitates efficient management, operations, and system and subsystem development and test in every phase of a space mission's life cycle. DNP resources are emplaced

and continuously improved by the ongoing DNP Project. The DNP Project at JPL is charged with emplacing processes for building and operating space mission systems that can adapt to the changing times while sustaining JPL's tradition of technical excellence.

Presently, TMOD is supporting a number of Flight Projects including Voyager, Ulysses, Galileo, Mars Global Surveyor, Cassini and others.

Voyager	The two Voyager missions have carried out scientific investigations of Jupiter, Saturn, Uranus, and Neptune. The Voyager 1 spacecraft is following a course that will take it out of the solar system and is returning valuable data from previously unsampled regions; Voyager 2, having made its encounter with Neptune in August, 1989, is continuing on a course away from the solar system.
Galileo	The primary purpose of Project Galileo was to investigate Jupiter by sending a probe to penetrate the planet's atmosphere and relay data through its orbiter to Earth. In addition, by performing a series of orbit maneuvers and gravity-assisted flybys, the orbiter spacecraft encountered all of the major moons of Jupiter as well as observing the planet itself during the orbital operations period of some two years. This it did successfully. The Galileo Project is now on an extended mission and is expected to end during the performance of this contract.
Ulysses	The primary objectives of the Ulysses mission were to investigate, as a function of solar latitude, various properties of the sun, the solar wind and other physical phenomena. Secondary mission objectives were to take advantage of the excursion to Jupiter, and focus on interplanetary physics and measurements of the Jovian atmosphere during the flyby. This it did successfully. The mission is a joint venture of the European Space Agency and NASA.
Cassini	Cassini is sending a spacecraft to explore Saturn, and will deliver a probe into the atmosphere of the principal Saturnian satellite, Titan. The objective is to determine the composition and behavior of Saturn and its rings, and of the various satellites of the Saturnian system. The Titan probe is a development of the European Space Agency.
Mars Global The Surveyor	Mars Global Surveyor is a Mars scientific mapping mission. spacecraft is carrying a complement of new instruments to

Mars in order to provide a long-lived orbital platform from which these instruments can examine the entire Martian surface, atmosphere and interior. Measurements are being collected from low-altitude, nearly polar orbits, over the course of one complete Martian year--the equivalent of about two Earth years or 687 Earth days.

A general description is presented for each functional area, and immediately followed with a detailed description of the support effort and task requirements. The functional areas do not necessarily reflect the JPL cognizant organization, and in some instances consist of a combination of task and support effort (generally referred to as level-of-effort). All efforts within a functional area are clearly addressed as task or support effort. Staffing requirements are expected to fluctuate in all areas and JPL reserves the right to re-designate support effort or task by modification of the Technical Description Document (TDD). All JPL documentation and Standards cited herein will be made available to the Contractor upon request. Note that the categories of "Inputs," "Functions Performed," "Outputs," and "Performance Requirements" in each task or subtask description are intended to be indicative of the work to be performed and not an exhaustive description of the work.

Definitions:

1. **Support Effort** - Technical direction of these support services is the direct responsibility of a JPL Cognizant Supervisor/Engineer. Administrative actions are the responsibility of the Contractor.
2. **Task Effort** – The Contractor is responsible for the performance of the contract task. The Contractor is given the responsibility to manage and perform the task as specified in the TDD. JPL will monitor the task performance, provide direction and technical assistance as required.
3. **Active Data Storage** – Temporary storage of data in a form and location so that it can be quickly retrieved for display and processing. It is not long-term data archiving and curation. In many cases, the datasets are modified (updated and/or re-calibrated) during the life of the mission. Duration of storage depends upon which stage of processing the data is in, the data flow, and upon the Flight Project's mission requirements.
4. **AMMOS Workstations** – In this context, AMMOS workstations are computer hardware that utilize AMMOS provided software and are used to support mission operations inside the AMMOS network operations security firewall. This definition applies without regard to who purchased and/or operates the equipment.
5. **Core Competency** – Core competencies are those technology-based skills which JPL has domain knowledge and that domain knowledge does not exist in industry. Examples include deep space mission planning, navigation, integrated sequence development and execution, and flight control operations.
6. **Core Systems** – Core systems (hardware and software) are those systems and subsystems, or technologies, which JPL has domain knowledge, and the domain knowledge for them does not exist in industry. For example, weak signal detection and precision planetary navigation.
7. **CSOC Data Systems Operations Data Delivery Point (DSO-DDP):**
 - **Telemetry:** Operations of the hardware and software that delivers the telemetry (raw, frames, or packets) to the Flight Project Database.
 - **Command:** Operation of the command central data system that makes the command connections between the DSN and the Flight Project.
 - **Radiometric:** Operates the systems that perform the radiometric data conditioning and delivers the edited files to the Flight Project or Multimission Navigation.

Sustaining and maintenance of the hardware which CSOC operates to perform the above three functions.

8. **Domain Knowledge** – The collective learning in the organization in how to coordinate the appropriate technology-based skills and to integrate the multiple streams of technologies to achieve or produce a product (or products) that is unique in the world.
9. **Flight Project Specific Workstations** – In this context, Flight Project specific workstations are unique computer hardware that support Flight Project mission operations and do not use AMMOS provided software, even if they are located within the AMMOS network operations security firewall.
10. **Flight System** – The components of the mission flown in space. The hardware and software integrated on or as part of the spacecraft.
11. **Institutional** – In this context, it is the hardware and software that supports the business, engineering, and science activities of JPL, but is not involved directly in the execution of mission operations.
12. **Legacy Missions** – These missions are defined as Galileo, Cassini, Mars Global Surveyor and Ulysses-Voyager.
13. **Maintenance** – Maintenance is defined as those activities where resources are applied toward repairing failed equipment or subsystems, or keeping equipment or subsystems in operational condition. Examples are:
 - Replacement of assemblies/boards with spares
 - Routine calibration
14. **Non-core Systems** – Non-core systems are those equipment or subsystems (hardware and software) for which industry and JPL have domain knowledge. For example, tracking station telemetry and command subsystems and point-to-point ground communications.
15. **Operations** – Operations are defined as those resources associated with using subsystems.
16. **Sustaining** – Sustaining is defined as those activities whose primary driver is keeping an existing subsystem maintainable at a reasonable cost. It generally involves some modification of configuration items. It does not include activities where new major capabilities or services are added, or where significant architectural changes are made. It does include

anomaly corrections and routine modifications in software (e.g., software table updates) or hardware (e.g., complying with an ECR). Examples are:

- Sun or Hewlett-Packard Workstation Replacement
 - Adding or Replacing Workstation Peripheral Devices
 - Adding routine codes to communications software
 - Installing new versions of COTS operating system software
17. **Upgrades** – Upgrades are defined as those activities that are primarily driven by adding new services, capabilities, capacity increases, or functions.

1.0 CONTRACT MANAGEMENT OFFICE (Task Effort)

The Program Manager is responsible for the performance of the total effort of the contract. The Contractor shall furnish the staffing to support the Program Manager in those administrative activities that are necessary for Contract performance. As a minimum, the CMO functional areas shall include accounting and finance, contract administration, purchasing, and employee relations.

1.1 General Management

The Contractor shall provide the necessary management to conduct the various tasks defined by this TDD. The Contractor interface with JPL shall exist at various levels for the purpose of:

- Coordination of policies, guidelines and requirements for task performance and technical direction.
- Monitoring and evaluation of the Contractor's performance.
- Definition and clarification of tasks.
- Coordination between the Contractor's task functions and outside agencies, including organizational elements at JPL.
- Establishing guidelines and policies at the supervisory level that will govern the interfaces at the working levels.

This task requires the Contractor to provide the overall management required by this Contract. Administration functions such as recruiting, personnel administration, wage and salary administration, industrial relations, cost control and reporting, and timekeeping directly related to this Contract are the responsibility of the Program Manager. The Program Manager interfaces with and is responsible to the designated JPL Contract Technical Manager for performance of all tasks under this Contract. The Contractor will comply with JPL requirements for Government property control, procurement, facilities and safety as specified in the terms of the contract. The Contractor will comply with the security requirements as described in JPL Security Document No. D-7155C or latest version.

1.1.2 Personnel

The Contractor shall maintain a formal system for adding and/or deleting positions based upon JPL's task

requirements, including an updated monthly report. The Contractor shall establish and maintain a position description for each position that reflects personnel education and experience requirements to assure that the proper personnel are assigned to the tasks. JPL will audit these position descriptions.

1.1.3 Cost Reporting

There shall be a timely cost accumulation and continuous budgeting function so that costs are controlled and properly charged. Budgetary cost estimates shall be provided to JPL, as required.

1.1.4 Safety

In accordance with Article 6, Safety and Health and AGP No. 36, Safety and Health, of the Contract, the Contractor shall establish a safety program implementing all applicable safety regulations as required by DRD FM008. The Contractor shall:

- 1.1.4.1** Provide initial safety training to all new employees, including emergency actions to ensure proper employee reactions to non-standard (personnel safety) conditions.
- 1.1.4.2** Provide periodic follow-on safety training and review of safety procedures.
- 1.1.4.3** Maintain a continuing employee safety awareness program. As a minimum this program shall include:
 - Emergency routes during work-station evacuation when required by law.
 - Use and location of fire extinguisher.

The Contractor also shall expeditiously report all serious accidents and any incidents or events which might have legal implications; cause unfavorable publicity; or impact Laboratory operations or mission support.

1.1.5 Report Requirements

Required reports are listed in Article 2 and in the Contract Data Requirements List (CDRLS) in Exhibit II of the Contract.

1.2 Management of Support Effort

Support provided under this effort is on an award fee basis as described in Article 3 of the Contract. The Contractor is required to perform the personnel administration and provide qualified personnel.

2.0 SYSTEMS DEVELOPMENT (Support Effort)

The objective of systems development is to provide qualified staffing as required by JPL to support technical needs in the following activities:

- * Development of spacecraft systems, navigation systems, data systems and subsystems and associated software configuration management, and the end-to-end information system design including post mission data analysis.
- * Flight projects, integration and test, and various subordinate projects and operations.

2.1 Science and Mission Planning

The Science and Mission Planning (S and MP) element of the mission operations organization provides the set of plans that are implemented by other elements in order to produce the science data return, which is the product of all planetary missions. As discussed below, this set of plans is usually expanded to a substantial level of detail before being passed on to the flight engineering element for further expansion.

Within the S and MP element, the science planning function identifies the desires of the science "customers" and converts them into the form of input needed by the Project Mission Operation System (MOS). The mission planning function then integrates these requests for science activity into other activities necessary to operate the spacecraft and operating constraints imposed by project resources and system capabilities.

Navigation system development support provides assistance to the mission design effort on trajectory accuracy.

Initial end-to-end information systems design and engineering can be a part of these tasks since added constraints or opportunities may be identified due to system constraints.

2.2 Ground Data Systems Support

Skilled engineering and technical personnel support the functional requirements development, design, development, implementation and operations of computer and network systems (see Appendix A, Roles and Responsibilities).

2.3 Spacecraft and Science Support

Skilled engineering and technical personnel to support spacecraft and science systems development.

2.4 Integration and Test

This support effort covers planning and implementation of hardware and software testing for spacecraft systems. Documentation of plans, procedures and results, selection of test tools and follow-up on problems identified during testing are important elements of this function (see Appendix A, Roles and Responsibilities).

3.0 MISSION OPERATIONS

Mission Operations consists of engineering and operational disciplines required for spaceflight operations support.

3.1 Flight Engineering (Support Effort)

The objective of the flight engineering support effort is to deliver a properly functioning spacecraft to the required places at the required times. "Properly functioning" means with all subsystems in good working order, including a proper sequence load in the on-board computer. In order to accomplish this objective, flight engineering is organized into the three disciplines of spacecraft: engineering, sequencing, and navigation. Most of this work is done post launch, but prelaunch activities include working with the systems development people to ensure operability of the MOS and training the flight engineering teams for operations.

3.2 Flight Operations Control (Support Effort)

The flight operations control support effort is responsible to the TMOD for the control of the spacecraft and for ensuring maximum and timely return of scientific data. Flight operations works under the Project Operations Manager. A flight operation control team, usually referred to by projects as the "mission control team," is formed in the mission pre-launch phase, when it is responsible for operations and resource planning, documentation, training, and testing. From launch, it is responsible for operations control and direction of other operations support teams. The team provides support and ensures adequate resource availability. It also maintains documentation and provides status reports, as necessary. Finally, it coordinates planning and sequence information to accomplish its operational responsibility (see Appendix A, Roles and Responsibilities).

3.3 Planning and Support Services (Support Effort)

The Contractor shall provide staffing as required by JPL to support the Mission Support Engineers (MSE) in their efforts to ensure that all aspects of the SFOF facility and operational support provided to flight project(s) are implemented and meet performance requirements. This support effort includes communications, drafting and illustrating, scheduling of flight support and other engineering support, as required.

3.4 Resource Allocation Process (Support Effort)

The Contractor shall provide staffing as required by JPL to support the Resource Allocation Planning Team (RAPT) that is part of the Resource Allocation Process (RAP). RAP is the process for negotiating support requirements between the multiple project users of the Deep Space Network (DSN) to fit the committed service into the available resources.

3.4.1 Resource Allocation Planning Team

The Resource Allocation Planning Team is a JPL-led effort that provides preliminary weekly allocations that are reviewed and discussed at negotiation meetings that are held on a periodic basis. These meetings include representatives from each user organization and are held to resolve contention for a period of approximately two months to twelve months into the future. The RAPT prepares and presents recommendations at this meeting to assist in the resolution of contention between the users for the next two or three years.

3.4.2 Long Range Planning

A Long Range Plan is published semi-annually and covers a period of ten years. This Plan shows all project user requirements for DSN support in detail on a weekly basis. The Plan identifies time commitments to users that cannot be met. The Plan also provides information on antenna subnet capacity and loading.

3.4.3 Joint User Resource Allocation Planning

Monthly Joint User Resource Allocation Planning (JURAP) meetings are held to discuss and resolve outstanding issues. The RAPT prepares preliminary weekly allocations that are reviewed and discussed at negotiation meetings that are held on a periodic basis. These meetings include representatives from each user organization and are held to resolve contention for a period of approximately two months to twelve months into the future.

4.0 MISSION SUPPORT SYSTEMS (Support Effort)

Mission Support Systems consists of providing qualified staffing as requested by JPL project areas to support the technical needs of the projects in the development, implementation or administration of administrative and technical application systems, computing software systems, networks and communications and operating systems software and UNIX Administration.

4.1 Administrative Applications Systems

Support responsibilities include, maintenance of production systems, solving problems for applications programmers using defined productivity tools, programming and analyzing new applications, providing technical direction and assistance with new software technologies, providing user liaison support to establish functional software requirements, and providing documentation support for software configuration management activities.

4.2 Project Management Systems, Project-Unique Computing Information Systems

Programmers are assigned to develop Flight Project user requested technical applications mission software or to optimize client-server architectures for project-unique and mission applications (see Appendix A, Roles and Responsibilities). This support often includes UNIX and PC software and hardware design, configuration and system administration. Database design and creation for project cost and schedule performance reports are supported as well as technical review and evaluation of computing hardware and software for potential acquisition.

4.3 Network & Communications Engineering and Administration

This support effort provides personnel to support network and communications engineering and administration support including network design, installation, and UNIX system administration for projects in TMOD, Space and Earth Science Programs Directorate (SESPD), Technology and Applications Programs Directorate (TAPD) as required. Frequent technical review and evaluation of commercially available network hardware components for potential acquisition is supported.

4.4 System Engineering, Computing Software, Project Unique Configuration Management, and Photo-lab Support

System engineering, computing software and project unique configuration management is present in virtually every area of a flight project including spacecraft, instrument payload, launch vehicle and ground system. It ranges in scope and application from the top level where ideas and plans are formulated to the component level where hardware and software is implemented. System engineering and configuration management in mission operations is the process that leads to the ground system and staffing requirements in a manner that is consistent with resource allocation, risk management and the needs of the science investigators. It provides the coordination for product development and functional verification.

JPL has responsibility for the architecture of deep space exploration operations systems. CSOC provides NASA with an Integrated Operations Architecture (IOA). The deep space exploration operations systems will evolve with time as consistent with the IOA to the extent that JPL can meet deep space exploration needs. The Contractor shall support JPL's efforts that will include CSOC engineering interfaces (See Appendix A, Roles and Responsibilities).

The Contractor shall provide System Engineering, Computing Software, Flight Project specific Configuration Management and Photo-lab staff as required to support:

1. Operating systems software programming on computing hardware located at the IPC.
2. Development and documentation of operational interface agreements
3. Development of operational plans and procedures
4. Development of the contingency plans
5. Development of training plans and preparation of personnel for operations
6. Development of flight sequence verification plans
7. Establishing criteria for system operations readiness
8. Verifying and validating system operational capabilities

9. Configuration management of mission applications and flight projects
10. Multi-mission photo-products generation
11. Trade studies on spacecraft to mission operations ground system
12. Development of uplink and downlink scenarios and processes
13. Preparation of system and operations concepts
14. Development and documentation of integration and test requirements
15. Establishment and documentation of system operations plans and procedures
16. Ground system and operations reviews
17. Integration of data system components
18. Integration and test planning activities

5.0 Institutionally Provided Consolidated Equipment Hardware and Sustaining Engineering (Task Effort)

The Contractor shall supply integrated computer hardware and sustaining engineering for the institution, technical support services covering hardware and software acquisition services, and administrative and clerical support (See Appendix A, Roles and Responsibilities).

Task functions to be provided by the Contractor are equipment hardware and sustaining engineering services for JPL institutionally supported computing systems, and the required ancillary activities necessary to support these task functions. The Contractor shall be responsible for all management, direct supervision and administrative activities associated with these efforts.

The Contractor shall perform all administrative functions associated with this task, including internal billing of all work accomplished. The administrative functions shall be compatible with the cognizant Section's work control and information management system. Internal billing shall be compatible with JPL's automated accounting processes and procedures.

Sustaining of non-AMMOS mission operations computers consists of real and non-real time support of flight project-specific equipment. The Contractor shall provide shift coverage as required to support the flight projects.

5.1 Institutionally Provided Equipment Hardware and Sustaining Engineering Services

The Contractor shall provide hardware and sustaining engineering services for a variety of JPL institutional and flight project specific supported computer and communications systems and equipment including non-AMMOS minicomputer, non-AMMOS micro-processor-based workstations and companion peripheral and communications network devices and other equipment as required.

5.1.1 Inputs

JPL will provide:

1. Performance requirements (e.g., Mean Time To Recover [MTTR], time to respond, etc.)
2. Standard or special work requests by email, telephone, fax, etc.

5.1.2 Functions Performed

The Contractor shall provide:

Hardware and sustaining engineering technical support (e.g., operational equipment configuration changes, repair, relocation, etc.).

5.1.3 Outputs

The Contractor shall provide:

1. Completed work orders
2. Equipment configured to support the JPL customer
3. Service request summaries and history reports.

5.1.4 Performance Requirements

The Contractor will be measured on how well it:

1. Meets the four-hour response time for reported failures during regular scheduled workdays
2. Installs and relocates equipment within the negotiated time frames
3. Meets work order cost estimates provided to the customer
4. Responds to special requests.

5.2 Institutional Minicomputer, and Workstation Sustaining and Hardware Engineering

The Contractor shall provide institutional sustaining engineering, installation, and continuing maintenance support on government non-AMMOS minicomputers, workstations, and associated peripheral equipment (See Appendix A, Roles and Responsibilities).

5.2.1 Inputs

JPL will provide:

1. Performance requirements (e.g., Mean Time To Recover [MTTR], time to respond, etc.)
2. Standard service requests, reported failures, and special requests by email, telephone, fax, etc.

5.2.2 Functions Performed

The Contractor shall:

1. Provide hardware and sustaining engineering technical support (e.g., operational equipment configuration changes, repair, relocation, etc.) for non-AMMOS workstation and minicomputers such as, Digital Equipment Corporation (DEC), SUN Microsystems and Hewlett Packard equipment
2. Coordinate remote location repair services when requested by JPL.

5.2.3 Outputs

The Contractor shall provide:

1. Completed service requests
2. Equipment configured to support the JPL customer
3. Work order summary and history reports.

5.2.4 Performance Requirements

The Contractor will be measured on how well it:

1. Meets the negotiated response time for reported failures during regular scheduled workdays
2. Installs and relocates equipment within the negotiated time frames
3. Meets work order cost estimates provided to the customer
4. Responds to special requests.

5.3 Institutional Sustaining Stores

In the Contractor's facility:

1. Using Contractor-generated, JPL-approved, procedures, the Contractor shall operate and maintain a supply store for the purpose of providing supplies, parts and subassemblies in support of non-AMMOS JPL institutional and flight project specific equipment.
2. Receive and process all incoming JPL and Contractor purchased material, equipment and related documents.

5.3.1 Inputs

JPL will issue to the Contractor:

1. Purchase requests/orders
2. Standard service requests
3. Shippers and/or invoices
4. Standard and special requests from JPL/NASA.

5.3.2 Functions Performed

The Contractor shall provide material receiving and shipping services as follows:

1. Unloading, delivery, and control
2. Shipping
3. Purchasing
4. Inventory and maintenance, including warehousing
5. Cost accounting.

5.3.3 Outputs

The Contractor shall generate:

1. Yearly stores inventory reports

2. Inventory accountability and reports to JPL cognizant personnel
3. Parts available reports to technicians/requester.

5.3.4 Performance Requirements

The Contractor will be measured on its delivery of parts and sub-assemblies in the time frame and at the costs agreed to with JPL.

5.4 Institutional Hardware and Sustaining Engineering Administration and Analysis

The Contractor shall manage the JPL institutional equipment pool and operate a Hardware and Sustaining Engineering Management Information Control System to plan, schedule, monitor, control and provide support for on-going sustaining engineering functions (See Appendix A, Roles and Responsibilities for CSOC interfaces).

5.4.1 Inputs

JPL will issue to the Contractor:

Standard service requests, reported failures, and special requests by email, telephone, fax, etc.

5.4.2 Functions Performed

The Contractor shall:

1. Provide equipment utilization records and issue load forecast reports.
2. Generate and maintain the equipment pool management plan, including recommended adjustments to equipment charges.
3. Provide and maintain a database that provides equipment inventory by customer, location and account number. Provide this information as requested.
4. Provide current information on the progress of each work order. Establish measures of sustaining engineering and equipment performance (MTBF, MTTR, etc.) when requested. Provide sustaining analysis to improve

maintenance and sustaining effectiveness and maintainability. Provide other management reports to JPL as required.

5.4.3 Outputs

The Contractor shall provide:

1. Monthly financial reports detailing equipment and charges. Metrics on planned versus actual costs
2. Failure trend analysis reports, e.g., MTBF
3. Metrics on installation/repair and response times, e.g., MTTR.

5.4.4 Performance Requirements

The Contractor will be measured on:

1. How often reports are delivered within agreed upon time limits
2. The accuracy of reports.

5.5 Institutional Security and Communication Maintenance

Provide technical services (engineering, installation, integration and continuing maintenance) and logistics support services to JPL's security systems and to JPL's and NASA's communications systems.

5.5.1 Inputs

1. Communications Service Requests (CSR's), Service Requests (SR's)
2. Special requests
3. Facility requests

5.5.2 Functions Performed

Engineer, install and modify systems and subsystems; and provide continuing maintenance service for the equipment listed below:

1. Wide and local area public address system
2. Intercommunications systems
3. Inter-NASA center video-conferencing systems
4. Radio paging systems
5. Tactical radio systems
6. Underground cable systems
7. Telecommunications equipment and systems

5.5.3 Outputs

1. Closed out CRS's, SR's and facility requests.
2. Work order summary and history reports.

5.5.4 Performance Requirements

1. Installation completed on time and within the costs estimate agreed upon.
2. Equipment returned to customer as negotiated.

6.0 Institutional Enterprise Information System Applications and Operations (Task Effort)

The Contractor shall provide Enterprise Information System (EIS) security, applications and system administration for the development and operation of EIS environments. These activities include, but are not limited to, installing, developing, testing, integrating and administering systems and applications. The Contractor shall also support the implementation, monitoring, and maintenance of institutional Web servers, public domain UNIX and PC Tools, the institutional X.500 Directory Service, the institutional E-Mail Service, the EIS Operations Center (EIS OPS), and local and remote organizations. (See Appendix A, Roles and Responsibilities for interfaces with the CSOC contractor).

6.1 Institutional EIS Infrastructure Operations

The Contractor shall provide EIS infrastructure operations as the institutional interface with the JPL application designers, developers, integrators, testers, and other users as required.

6.1.1 Inputs

JPL will provide:

1. Computer and communications equipment
2. Service requests (trouble tickets) and special requests by email, telephone, fax, intranet, automated paging, etc.
3. Functional requirements including JPL computer, data, and access security policies and procedures
4. Notice of configuration control for mission critical events.

6.1.2 Functions Performed

The Contractor shall provide:

1. EIS operations during the working hours of 6:00 a.m. to 6:00 p.m. PST/PDT, Monday-Friday
2. On-call operations from 6:00 p.m. to 6:00 a.m. Monday-Friday and 24 hours Saturday and Sunday by Emergency Voice Mail Message

3. Maintenance of service request/trouble ticket database
4. Triage and assignment of work in support of detailed problem resolution
5. Tuning of application, servers, and peripherals
6. EIS server maintenance, configuration control, and data security
7. Backup application and server configurations
8. Monitor, troubleshoot, and track EIS security violations as required.

6.1.3 Outputs

The Contractor shall provide:

1. Timely documentation of problem resolution
2. Timely notification of service outages and mission critical events
3. Reports as required.

6.1.4 Performance Requirements

The Contractor will be measured on how well it meets cost, schedule, and requirements.

6.2 Institutional EIS Infrastructure Applications

The Contractor shall provide EIS infrastructure applications and sustaining engineering support. This support includes, but is not limited to, ADSM, AFS, DCE, POP3, IMAP4, Bulletin Board, Real Time Event Notification, Tivoli, Remedy, etc, on an enterprise scale. Development, test and integration, installation, documentation, and administration of the above applications is supported.

6.2.1 Inputs:

JPL will provide:

1. Computer hardware and software, and communications equipment
2. Service requests (trouble tickets) and special requests by email, telephone, fax, intranet, automated paging, etc.
3. Functional requirements including JPL computer, data, and access security policies and procedures
4. Integration and test requirements.

6.2.2 Functions Performed

The Contractor shall provide:

1. Maintenance, sustaining engineering, and implementation of EIS applications as required
2. Support operations and users as required
3. Support the EIS procurement needs
4. Support to Institutional EIS Configuration Control and Configuration Management
5. Documentation including operations procedures and manuals as required
6. Applications and sustain them.

6.2.3 Outputs

The Contractor shall provide:

1. Applications and intermediate products as required, such as designs, reviews, costs, schedules, and documentation
2. Recommendations for hardware and software procurements
3. Active institutional data storage and backups
4. Reports as required.

6.2.4 Performance Requirements

The Contractor will be measured on how well it:

1. Meets cost and schedule
2. Meets operational performance requirements
3. Resolves problems in a timely manner
4. Proposes design solutions
5. Generates documentation
6. Provides required reports on time.

7.0 Institutional Network Operations (Task Effort)

The Contractor shall provide for the operational support of the JPL Institutional Network. The support shall include staffing necessary to operate a central point of contact (the Network Operations Center [NOC]) for all network related issues including the monitoring of network performance and monitoring of approximately 13,000 user-devices and 1000+ managed network communications components 24 hours per day, year round. The NOC shall be the core facility for the Contractor-provided Network Operations Team (NetOps), and shall be secured by an access control system incorporating a cypher lock or equivalent with building badge reader entry. The Contractor shall also support and operate the Backup NOC (BNOC) as required. The BNOC is located in JPL Building 171 room B9, and it has a similar access control system in place. The Contractor shall be required to monitor the network as well as perform the day-to-day functions required to enable, restore, and maintain network service to JPL users.

7.1 Inputs

JPL will provide:

1. Service requests (trouble tickets) and special requests by email, telephone, fax, intranet, automated paging, etc.
2. JPL Network policies and procedures
3. Notice of configuration control for mission critical events
4. Specifications for upgrades or deployment of equipment
5. Identification of special NOC coverage periods
6. Network monitoring equipment.

7.2 Functions Performed

The Contractor shall:

1. Provide Institutional Network Operations during the working hours of 7:00 a.m. to 5:00 p.m. PST/PDT, Monday-Friday
2. Provide On-call Institutional Network Operations from 5:00 p.m. to 7:00 a.m. Monday-Friday and 24 hours Saturday and Sunday

3. Generate, process, and respond to service requests (trouble tickets) for service (network activation, deactivation, connection, disconnection, removal, etc.) and reports of outages per established JPL procedures and processes.
4. Perform network monitoring and triage on network problems
5. Disseminate network status to users and other helpdesk entities (e.g., OAO/DNS Alliance Helpdesk, EIS Helpdesk, etc.) and generate outage notifications ('netdown' notices) as required
6. Perform upgrades, installation, and deployment of equipment
7. Maintain inventory levels as required
8. Perform quality assurance inspections, audits, and maintenance of Hub rooms
9. Report/Suggest improvements to procedures
10. Support procurement requests and administrative functions as required
11. Maintain IP Address Management databases and connection databases as required per established JPL procedures
12. Perform network Hub room security monitoring, video distribution and management, network configuration management and control, cable installation and management, and on-call support as required.

7.3 Outputs

The Contractor shall:

1. Close or complete requests (Service requests or Trouble Tickets) for service with all required information
2. Issue "netdown" notices as required
3. Provide documentation (e.g., reports, inventories, configuration management data reports, scanner data, etc.) as required.

7.4 Performance Requirements

The Contractor will be measured on how well it:

1. Meets service level requirements
2. Completes requests for service
3. Resolves network problems
4. Responds to users
5. Monitors the network.

8.0 Institutional Network and Telecommunications (Support Effort)

JPL uses Pacific Bell Centrex to provide telephone services to personnel at JPL Oak Grove and Woodbury locations. Pacific Bell performs the majority of the telephone operations at JPL. The Contractor shall support six general activities not performed by Pacific Bell:

- Telephone Coordination
- Telephone Repair
- Telephone Equipment Supply
- Telephone Invoice Processing
- Cable Plant Coordination
- Network and Telecommunications Engineering.

The Contractor shall provide personnel as required:

1. To assist users in requesting telephone services to meet their requirements and to assist users with telephone move add and change requests. These requests may be as simple as installing a single telephone or as complex as providing telephone service for an entire building. The Contractor personnel shall provide or arrange for end user training as required on telephone equipment and services and training on the telephone ordering process.
2. To respond when telephone problems are reported and make the initial problem determination. Contractor personnel shall resolve these problems if it involves local equipment. Problems with outside vendor provided equipment and services shall be referred to the appropriate vendor for resolution. These Contractor personnel shall also manage the supply of spare telephone equipment.
3. To procure and distribute telephone equipment, to maintain the information necessary to charge back users for equipment and services provided and to reconcile equipment received against equipment deployed in inventory. The equipment to be procured includes but is not limited to telephones and telephone accessories, cellular phones and cellular phone accessories, pagers, facsimile machines and ISDN support equipment such as NT-1s. JPL will determine the type, make and model of equipment to be procured. The Contractor shall enable cellular phone and pager services per user's requests and in compliance with JPL policy.
4. To process invoices for JPL telephone equipment and services and ensure the appropriate information is forwarded to JPL Accounts

Payable for payment, forwarded to Pacific Bell, and entered into JPL's financial system for user chargeback.

5. To coordinate the installation and maintenance of the JPL cable plant.
6. To augment the existing Network and Telecommunications Engineering staff.

9.0 Facilities Services (Task Effort)

For any facility utilized by the Contractor and/or leased by the Contractor to support JPL institutional tasks or Flight Projects, the Contractor shall provide for each building, while supporting JPL institutional tasks and Flight Projects, suitable facilities related services. Minimally, these services shall cover:

1. Contractor Facility Engineering
2. Contractor Facility Planning
3. Contractor Facility Maintenance
4. Contractor Facility administration and management of all building services and functions.

These facilities and the supporting building services covered by this task are for the Contractor leased facilities. This does not imply that facilities or services at the Contractor leased facilities are shared with, replaced by, or overlap with any of the services such as CSOC Plant Engineering and other facility maintenance functions provided by the CSOC contractor(s) for CSOC operated or leased facilities (e.g., Goldstone). Facilities at 4800 Oak Grove Drive, Pasadena, California 91109 are shared with CSOC and JPL (i.e., Building 230), but facilities services are provided under a separate JPL contract with Jacobs Engineering.

For this task, the Contractor shall insure suitable facilities and building security are supplied to support JPL provided computer equipment. These include such areas as electrical power, back-up generators (as required during JPL determined Flight Project critical events), physical access security and Heating, Ventilation and Air Conditioning (HVAC) systems to name a few. The contractor shall maintain building drawings and diagrams as may be deemed necessary by JPL for support of JPL projects.

Appendix A.

Roles and Responsibilities for the MACS Contractor

Mission And Computing Support Contract

Contract No. 958226

Technical Description Document

Appendix A. Roles and Responsibilities for the MACS Contractor

MACS TDD Element/Area	MACS Responsibility	SDSIO Responsibility	CSOC Responsibility
1.0 Contract Management Office 1.1 General Management	Provide and maintain interfaces with CSOC, SDSIO, and other JPL contractors as required	Provide and maintain interfaces with MACS, CSOC, and other JPL contractors as required	Provide and maintain interfaces with SDSIO, MACS, and other JPL contractors as required
2.2 Ground Data System Support	Provide support for the development, integration, testing and delivery of Flight Project supplied applications and adaptations of the MGDS as required	N/A	CSOC has integration, test, and data delivery responsibility for CSOC provided end-to-end services to the CSOC DSO-DDP (see Definitions)
2.4 Integration and Test	Provide support for spacecraft systems hardware and software testing as required	N/A	CSOC has integration, test, and data delivery responsibility for CSOC provided end-to-end services to the CSOC DSO-DDP
3.2 Flight Operations Control	Provide interfaces to CSOC DSO on procedures and documentation	N/A	Provide CSOC DSO interfaces to the MACS Contractor as required
4.2 Project Management Systems, Project-Unique Computing Information Systems	Provide development, integration, operations, maintenance and sustaining support to these functions when required	Similar functions to MACS except for science databases	Support integration, test, and operations for CSOC end-to-end services to the CSOC DSO-DDP when data flow to these functions is required

**Appendix A. Roles and Responsibilities for the MACS Contractor
(continued)**

MACS TDD Element/Area	MACS Responsibility	SDSIO responsibility	CSOC Responsibility
4.4 System Engineering, Computing Software, Project Unique Configuration Management, and Photo-lab Support	Provide support for JPL system engineering activities and JPL efforts that will include integration of JPL architectures for deep space exploration operations systems with the CSOC Integrated Operations Architecture (IOA). The Contractor shall maintain interfaces with CSOC engineering to ensure consistency of JPL architectures with the CSOC provided IOA.	N/A	Provide IOA for NASA that will be utilized to the extent practicable to support JPL deep space exploration operations systems.
5.0 Institutionally Provided Consolidated Equipment Hardware and Sustaining Engineering	Provide interfaces to JPL contractors for JPL Institutional hardware and sustaining engineering support for MACS supported equipment and non-AMMOS workstation platforms	Provide MACS interfaces as required	N/A

**Appendix A. Roles and Responsibilities for the MACS Contractor
(continued)**

MACS TDD Element/Area	MACS Responsibility	SDSIO responsibility	CSOC Responsibility
5.2 Institutional Minicomputer, and Workstation Sustaining and Hardware Engineering	Provide sustaining and hardware engineering support on all equipment and non-AMMOS workstation platforms provided or supported under this contract to Institutional users	Provide interfaces to MACS Contractor as required	N/A
5.4 Institutional Hardware and Sustaining Engineering Administration and Analysis	Provide interfaces to JPL, CSOC and other JPL contractors to coordinate and process Service Requests, CR's, FR's, and CSRs as required for Institutional users or specific Flight Projects	Provide interfaces as required to support the processing of MACS/JPL Service Requests, CR's, FR's, and CSRs where SDSIO provided equipment is involved.	Provide interfaces as required to support the processing of MACS/JPL Service Requests, CR's, FR's, and CSRs where CSOC provided equipment is involved.
6.0 Institutional Enterprise Information System Applications and Operations	Provide interfaces and support as required to CSOC AMMOS network installed systems	N/A	Provide access to, interfaces to, and support for JPL EIS sustaining of AMMOS network installed EIS systems
7.0 Institutional Network Operations	Provide interfaces to CSOC to support the AMMOS-to- JPLNet (JPL institutional network) connection	N/A	Provide access to, interfaces to, and support for the AMMOS network connection to JPLNet